IV. *Obſervations on Aphides, chiefly intended to ſhow that they are the principal Cauſe of Blights in Plants, and the ſole Cauſe of the Honey-Dew. By the late Mr. William Curtis, F. L. S.*

Read May 6, 1800.

THE *Aphis*, or Blighter, as we now for the firſt time venture to call it, from its being the moſt general cauſe of what are termed blights in plants, forms a highly intereſting tribe of inſects. In point of number, the individuals of the ſeveral ſpecies compoſing it ſurpaſs thoſe of any other genus in this country *.

Theſe inſects live entirely on vegetables. The loftieſt tree is no leſs liable to their attacks than the moſt humble plant. They prefer the young ſhoots on account of their tenderneſs, and on this principle often inſinuate themſelves into the very heart of the plant, and do irreparable miſchief before they are diſcovered. But for the moſt part they beſet the foliage, and are always found on the under ſide of the leaf, which they prefer, not only on account of its being the moſt tender, but as it affords them protection from the weather, and various injuries to which they would otherwiſe be expoſed. Sometimes the root is the object of their choice, which, from the nature of theſe inſects, one would not *à priori* expect; yet have I ſeen the roots of lettuces thickly beſet by them, and the whole crop rendered ſickly and of little value: but ſuch inſtances are rare. They rarely

* Reaumur, conſidering each *Aphis* as bringing forth ninety young, calculates that in five generations the produce from a ſingle one would be five thouſand nine hundred and four million nine hundred thouſand.

alſo attach themſelves to the bark of trees, like the *Aphis ſalicis*, which being one of our very largeſt ſpecies, and hence poſſeſſing ſuperior ſtrength, is enabled to penetrate a ſubſtance harder than the leaves themſelves.

As among caterpillars we find ſome that are conſtantly and unalterably attached to one or more particular ſpecies of plants, and others that feed indiſcriminately on moſt ſorts of herbage; ſo it is preciſely with the *Aphides:* ſome of them are particular, others more general feeders.

As they reſemble other inſects in the above reſpect, ſo do they alſo in being infinitely more abundant ſome years than others; and though, with regard to certain inſects, this variation (ſometimes wonderful in the extreme, as in the brown-tail moth which ravaged the quickſet hedges in 1782) is not eaſily accounted for, it is ſolved without much difficulty as to the *Aphis*, as will be ſhown in the ſequel. In the year 1793 they were the chief, and in 1798 the ſole, cauſe of the failure of the crop of hops. In 1794, a ſeaſon almoſt unparalleled for drought, the hop was perfectly free from them, while peas and beans, eſpecially the former, ſuffered very much from their depredations. Beans were in 1798 almoſt wholly cut off by them; indeed they ſuffer more or leſs every year by a black ſpecies of *Aphis*, particularly the latter crops. To potatoes, and even to corn, we have known them ſome years prove highly detrimental, and no leſs ſo to melons. To plants in ſtoves, greenhouſes and frames, where, from the warmth and ſhelter afforded them, a preternatural multiplication takes place, they prove extremely injurious, and many a rare and valuable plant alſo in the open ground of our botanic gardens falls a victim to theſe general depredators. Seeing, therefore, that our neceſſaries as well as luxuries of life are ſo materially affected by the inſects of this genus, an attempt to aſcertain ſome of the curious and important facts

relative to their hiſtory, and to make them more generally known, will not, we truſt, be unacceptable to the public. Such inquiries may poſſibly lead to the means of obviating the injuries they occaſion; and if they fail in this, they may tend at leaſt to correct the erroneous notions entertained of blights, not by the vulgar and illiterate merely, but even by perſons of education, who may frequently be heard to maintain that theſe inſects are brought by the eaſt winds; that they attack none but ſickly plants; with other notions, all as falſe in fact as unphiloſophical in principle.

Locuſts and caterpillars, famed for their devaſtations, are furniſhed with ſtrong jaws, by means of which they crop and wholly devour the foliage of plants. The *Aphis* deſtroys them in a different way. Inſtead of jaws and teeth it is provided with a hollow-pointed proboſcis or trunk, which, when the animal is not feeding, folds under its breaſt. With this inſtrument it pierces the plant, and imbibes its juices to ſupport itſelf; but theſe juices being eſſential to the life of the plant, it follows that, when they are drawn off, the plant, exhauſted, flags and periſhes, being in fact literally bled to death by theſe leech-like animalcules. Yet, ſo tenacious of life are plants in a healthy ſtate, that they in general only fall victims to the continued attacks of theſe inſects when in immenſe numbers. But it moſt commonly happens that if they do not wholly deſtroy a plant they deface it, and a ſmall number of *Aphides* are ſufficient to produce this effect. The leaves of ſuch trees and plants as have a firm texture and ſtrong fibres, though infeſted with theſe inſects, preſerve their form; but the more tender foliage of others, and flowers in general, cannot bear their punctures without curling up and becoming diſtorted; in conſequence of which they loſe their beauty entirely and irretrievably. The cultivators of plants, eſpecially in ſtoves and green-houſes, cannot be too much on their guard againſt the whole tribe of *Aphides*; for with what pleaſure can a large

large or choice collection be viewed, when there is ſcarcely a plant but what exhibits ſymptoms of diſeaſe occaſioned by vermin?

As the ſpecies of this genus are very numerous, and afford but few marks of diſtinction, Linnæus has contented himſelf with giving moſt of them trivial names, according to the particular plant on which they are found: a cloſe attention to them will, however, diſcloſe more diſtinctive characters than naturaliſts are aware of.

Aphides are deſcribed by the beſt informed authors as being generally oviparous and viviparous at different periods of the ſame year. Monſ. Bonnet, who had the honour of making this diſcovery in 1740*, ſays that in the ſummer the females are viviparous, but toward the middle of autumn they lay real eggs. De Geer obſerves, that the females of all the *Aphides* he had ſeen, conſtantly laid eggs, intended to preſerve the ſpecies during winter, and that he is therefore inclined to believe that the ſame takes place in all *Aphides* whatever. From the 24th of September to the 6th of December following, during which time Fahrenheit's thermometer had been as low as 29, I found the *Aphis ſalicis* to be conſtantly viviparous, though from the inclemency of the weather very few of theſe inſects at the period laſt mentioned remained on the trees, and thoſe few were ſoon after entirely cut off by the unuſual cold that took place, the thermometer falling to 4 degrees below 0.—Other *Aphides* are oviparous or viviparous according to the temperature of the air to which they are expoſed. In very cold weather they are oviparous, for this obvious reaſon: the eggs are capable of reſiſting cold more powerfully than the young. On the 22d of November ſame year as above, I found a conſiderable number of eggs which had been depoſited in ſome auricula plants by a ſmall green *Aphis*,

* Or rather Monſ. Trembley. See his Letter to M. Bonnet from the Hague: Oeuvres de Bonnet.

which

which infeſts plants very generally *, while the ſame *ſpecies*, on a geranium that I kept within doors, produced young. In mild winters I have obſerved, in the month of January, the ſame ſpecies of *Aphis* in great numbers on various ſpecies of primula without doors, and all the females viviparous. Theſe are facts which prove that all *Aphides* are not oviparous and viviparous at the ſame ſeaſon, but that ſome may be wholly viviparous; that all ſuch as are both oviparous and viviparous do not lay eggs toward the middle of autumn, nor at all during the winter, unleſs a certain degree of cold takes place.

Moſt people will think it a matter of very little moment to mankind whether an *Aphis* comes into the world with its head or its heels foremoſt:—it may be ſo; yet, as nature's hiſtorian, it is perhaps incumbent on us to notice this circumſtance. The young *Aphis* then is uſhered into the world with its feet foremoſt, ſee TAB. V. fig. 1., and this act of parturition, unimportant as it may appear, ſerves to diſplay the wiſdom of the all-provident Author of Nature. The female *Aphis* is uſually delivered of its offſpring as it ſits cloſe to the bark of the tree, but not ſuddenly and all at once. Two-thirds of the body of the young one is quickly protruded. When it gets ſo far, the power of expulſion ceaſes, and the delivery proceeds ſlowly. Time is thus given to the young one to learn the uſe of its legs, which it ſoon kicks about briſkly, and the firſt ſervice it employs them in is to clean away a white ſubſtance, the remains, perhaps, of the membrane in which it was enveloped in the womb.

* Theſe eggs were laid in ſmall, irregular groups, on the upper as well as on the under ſide of the leaves; they were of a perfectly black colour, and very viſible to the naked eye. I found afterwards that the eggs when recently excluded were green, from which colour they gradually changed to that which rendered them ſo conſpicuous. They were ſlightly attached to the leaf.

But

But what is of greater conſequence is, that it is enabled by their uſe to cling faſt to the bark of the tree as ſoon as it is brought forth, and thus to obtain its neceſſary nutriment.

Of ſome of the circumſtances attendant on the propagation of theſe minute animals accounts are related, deviating ſo wonderfully from the common courſe of nature, that they could not be credited, were not the authors of them known to be men of the niceſt and moſt accurate obſervation and of the ſtricteſt veracity. On this part of the ſubject I have little to ſay from my own obſervation; but, as ſome account of ſo extraordinary a part of their hiſtory may be expected in a paper of this ſort, I ſhall ſtate the facts, briefly obſerving that neither in the *Aphis ſalicis*, which at times I have watched with great attention, nor in any other ſpecies of *Aphis*, did I ever obſerve any ſexual intercourſe to take place. Whether this has ariſen from the extreme infrequency of ſuch a procedure, or from my not having obſerved theſe inſects at a proper time of the year, I know not; but, moſt undoubtedly, ſuch intercourſe does not take place between the different ſexes of *Aphis* as in other inſects. Yet Monſ. Bonnet, who may be ſaid to have almoſt taken up his abode with theſe inſects, informs us that he has frequently noticed ſuch connexion, which he deſcribes as taking place at one certain time of the year only; and that, from a female thus impregnated, many ſucceſſive generations will be produced without any further impregnation. He took the *Aphides* as ſoon as brought forth, and kept each individual ſeparate. The females of ſuch brought forth abundance of young. He took the young of theſe and treated them preciſely in the ſame manner. The produce was the ſame; and thus he proceeded to the ninth generation with the ſame ſucceſs: and ſo far from conſidering that as the utmoſt extent of the effect, he thinks it might be carried on to the thirtieth generation.

In

In moſt ſpecies of *Aphides* both males and females acquire wings at certain ſeaſons; but in this reſpect they are ſubject to great variation, there being ſome males and ſome females that never have wings; again, there are ſome females that become winged, while others of the ſame ſpecies do not.

In the quality of the excrement voided by theſe inſects there is ſomething wonderfully extraordinary. Were a perſon accidentally to take up a book in which it was gravely aſſerted that in ſome countries there were certain animals which voided liquid ſugar, he would ſoon lay it down, regarding it as a fabulous tale, calculated to impoſe on the credulity of the ignorant; and yet ſuch is literally the truth.

The ſuperior ſize of the *Aphis ſalicis* will enable the moſt common obſerver to ſatisfy himſelf on this head. On looking ſtedfaſtly for a few minutes at a group of theſe inſects while feeding on the bark of the willow, one perceives a few of them elevate their bodies, and a tranſparent ſubſtance evidently drop from them, which is immediately followed by a ſimilar motion and diſcharge like a ſmall ſhower from a great number of others. At firſt I was not aware that the ſubſtance thus dropping from theſe animals at ſuch ſtated intervals was their excrement, but was convinced of its being ſo afterwards; for, on a more accurate examination, I found it to proceed from the extremity of the abdomen, as is uſual in other inſects. On placing a piece of writing-paper under a maſs of theſe inſects, it ſoon became thickly ſpotted; holding it a longer time, the ſpots united from the addition of others, and the whole ſurface aſſumed a gloſſy appearance. I taſted this ſubſtance, and found it to be as ſweet as ſugar. I had the leſs heſitation in doing this, having obſerved that waſps, ants, flies, and inſects without number, devoured it as quickly as it was produced: but, were it not for theſe, it might no doubt be collected in conſiderable quantities, and, if ſubjected to the

proceſſes uſed with other ſaccharine juices, might be converted into the choiceſt ſugar or ſugar-candy. It is a fact alſo, which appears worthy of noticing here, that, though the waſps are ſo partial to this food, the bees appear totally to diſregard it.

In the height of ſummer, when the weather is hot and dry, and *Aphides* are moſt abundant, the foliage of trees and plants (more eſpecially in ſome years than others) is found covered with, and rendered gloſſy by, a ſweet clammy ſubſtance, known to perſons reſident in the country by the name of *honey-dew*: they regard it as a ſweet ſubſtance falling from the atmoſphere, as its name implies.

The ſweetneſs of this excrementitious ſubſtance, the gloſſy appearance it gave to the leaves it fell upon, and the ſwarms of inſects this matter attracted, firſt led me to imagine that the honey-dew of plants was no other than this ſecretion, which further obſervation has ſince fully confirmed. Others have conſidered it as an exudation proceeding from the plant itſelf. Of the former opinion we find the Rev. Gilbert White, one of the lateſt writers on natural hiſtory that has noticed this ſubject *.

But that it neither falls from the atmoſphere, nor iſſues from the plant itſelf, is eaſily demonſtrated. If it fell from the atmoſphere, it would cover every thing on which it fell indiſcriminately, whereas we never find it but on certain living plants and trees. We find it alſo on plants in ſtoves and green-houſes covered with glaſs. If it exuded from the plant, it would appear on all the leaves generally

* "June 4th, 1783. Vaſt honey-dews this week. The reaſon of theſe ſeems to be, that in hot days the effluvia of flowers are drawn up by a briſk evaporation, and then in the night fall down with the dews, with which they are entangled.

"This clammy ſubſtance is very grateful to bees, who gather it with great aſſiduity; but it is injurious to the trees on which it happens to fall, by ſtopping the pores of the leaves. The greateſt quantity falls in ſtill, cloſe weather; becauſe winds diſperſe it, and copious dews dilute it, and prevent its ill effects. It falls moſtly in hazy, warm weather." *See White's Naturaliſt's Calendar, p.* 144.

and

and uniformly; whereas its appearance is extremely irregular, not alike on any two leaves of the same tree or plant, some having none of it, and others being covered with it but partially.

But the phænomena of the honey-dew, with all their variations, are easily accounted for by considering the *Aphides* as the authors of it. That they are capable of producing an appearance exactly similar to that of the honey-dew, has already been shown. As far as my observation has extended, there never exists any honey-dew but where there are *Aphides*; such, however, often pass unnoticed, being hid on the under side of the leaf. Wherever honey-dew is observable about a leaf, *Aphides* will be found on the under side of the leaf or leaves immediately above it, and under no other circumstances whatever. If by accident any thing should intervene between the *Aphides* and the leaf next beneath them, there will be no honey-dew on that leaf. Thus then we flatter ourselves to have incontrovertibly proved that *Aphides* are the true and only source of the honey-dew.

We have found that where the saccharine substance has dropped from *Aphides* for a length of time, as from the *Aphis salicis* in particular, it gives to the surface of the bark, foliage, or whatever it has dropped on, that sooty kind of appearance which arises from the explosion of gun-powder, which greatly disfigures the foliage, &c. of plants. It looks like, and is sometimes mistaken for, a kind of black mildew. We have some grounds for believing that a saccharine substance, similar to that of the *Aphis*, drops from the *Coccus* also, and is finally converted into the same kind of powder.

In most seasons the natural enemies of the *Aphides* are sufficient to keep them in check, and to prevent them from doing any essential injury to plants in the open air. But seasons sometimes occur, very irregularly indeed, on an average, perhaps, once in four or six years, in which they are multiplied to such an excess, that the

uſual means of diminution fail in preventing them from doing irreparable injury to certain crops.

In ſevere winters we have no doubt but *Aphides* are very conſiderably diminiſhed; in very mild winters we know they are very conſiderably increaſed; for they not only exiſt during ſuch ſeaſons, but continue to multiply. Their enemies, on the contrary, exiſt, but do not multiply, at leaſt in the open air, during ſuch periods; and thus the *Aphis* gets the ſtart of them, and acquires an aſcendency, which once acquired is not eaſily overcome by artificial means, upon a large ſcale at leaſt, in the open air. Vain would be the attempt to clear a hop-garden of theſe pernicious vermin, or to reſcue any extenſive crop from their baneful effects. Violent rains attended with lightning have been ſuppoſed to be very effectual in clearing plants of them; but in ſuch caſe more is to be attributed to the plants being refreſhed and made to grow by the rain, of which they ſtood in need, than to any deſtruction of the *Aphides* themſelves, which, on an accurate examination, will be found to be as plentiful after ſuch rains as they were before; nor is wet ſo injurious to theſe inſects as many imagine, as is evident from the following experiment: On the 12th of May 1799, I immerſed in a glaſs of water the footſtalk of a leaf of conſiderable length, taken from a ſtove plant, beſet with *Aphides* of a dark lead colour, which were feeding on it in great numbers. On immerſion they did not quit the ſtalk, but immediately their bodies aſſumed a kind of luminous appearance from the minute bubbles of air which iſſued from them. They were put under water at a quarter paſt ſix in the evening, and taken out at a quarter paſt ten the next morning, having continued immerſed ſixteen hours. On placing them in the ſun-ſhine, ſome of them almoſt immediately ſhowed ſigns of life, and three out of four at leaſt ſurvived the immerſion. One of the ſurvivors, a male, very ſoon became winged, and another, a female, was

was delivered of a young one. Many years before this experiment, with a view to deſtroy the *Aphides* which infeſted a plant in my green-houſe, I immerſed one evening the whole plant, together with the pot in which it grew, in a tub of water. In the morning I took out the plant, expecting with certainty to find every *Aphis* dead; but to my great ſurpriſe they ſoon appeared alive and well: and thus, in addition to the other extraordinary phænomena attendant on theſe inſects, we find that they are capable of reſiſting the effects of immerſion in water for a great length of time. When taken from the plant on which they feed, and kept under water, they do not ſurvive ſo long; their ſtruggling in that caſe perhaps exhauſts them ſooner. This part of the ſubject might be puſhed much further: it is ſufficient for our purpoſe to have ſhown that wet is not ſo hurtful to them as is generally imagined.

Though no mode of deſtroying *Aphides* will perhaps ever be deviſed on a large ſcale in the open air by artificial means, we can accompliſh it moſt effectually when they infeſt plants in ſtoves, green-houſes, and frames, or in any ſituation in which we can envelop them for a certain time in clouds of ſmoke. Powders or liquids, however fatal to *Aphides*, muſt ever be ineffectual, from the trouble and difficulty of applying them ſo that they ſhall come in contact with thoſe inſects, ſituated as they uſually are; but in this reſpect ſmoke has every advantage, it penetrates and pervades their inmoſt receſſes. The ſmoke of common vegetables, however powerful, is found to be inadequate to their deſtruction, and hitherto no other than that of tobacco is found to be effectual. That, judiciouſly applied, completely anſwers the purpoſe, without injuring the plant. It moſtly happens in well managed houſes that a few plants only are infeſted with *Aphides:* in ſuch a caſe, the ſmoking of the whole houſe is a buſineſs of unneceſſary expenſe and trouble; and we would recommend to perſons who have large collections to make uſe

of a box of a commodious form that ſhall hold about a dozen plants of various ſizes, to be uſed as a ſort of hoſpital, in which infeſted plants may be ſmoked ſeparately, and the inſects more effectually deſtroyed, becauſe it may be rendered more perfectly ſmoke-tight.

To prevent the calamities which would infallibly reſult from the accumulated multiplication of the more prolific animals, it has been ordained by the Author of Nature, that ſuch ſhould be diminiſhed by ſerving as food for others. On this principle, we find that moſt animals in this predicament have one or more natural enemies. The helpleſs *Aphis*, the ſcourge of the vegetable kingdom, has to contend with many. The principal are the *Coccinella*, the *Ichneumon Aphidum*, and the *Muſca aphidivora*. Such as are unacquainted with the hiſtory of inſects will learn with ſome ſurpriſe that the *Coccinella**, a common inſect well known even to children by the name of the Lady-bird, is one of the greateſt deſtroyers of the *Aphides*, which indeed are its only food, its ſole ſupport, as well in its perfect as in its *larva* or grub ſtate. During the ſeverity of winter this inſect ſecures itſelf under the bark of trees, or elſewhere†. When the warmth of ſpring has expanded the foliage of plants, the female depoſits its eggs on them in great numbers, from whence in a ſhort time proceeds the *larva*, a ſmall grub of a dark lead colour ſpotted with orange: theſe may be obſerved in the ſummer ſeaſon running pretty briſkly over all kinds of plants; and if narrowly watched, they will be found to devour the *Aphides* wherever they find them. The ſame may be obſerved of the Lady-bird in its perfect ſtate. As theſe inſects in both their ſtates are

* All the different ſpecies of *Coccinella* feed on *Aphides*; the *bipunctata*, by far the moſt common, does the moſt execution.

† Many are found in houſes; for, early in May 1799, I counted on the window of my common ſitting-room, expoſed to the ſun, nineteen of the *Coccinella bipunctata*.

very

very numerous, they contribute wonderfully to diminish the number of *Aphides*. There is a saying which humanity has put into the mouths of children in favour of this insect *, now rendered more sacred by its great utility, which has happily rendered it a sort of favourite with them, and contributes usually to its escape from their dangerous clutches. Another most formidable enemy to the *Aphis* is a very minute, black and slender Ichneumon fly, the *Ichneumon Aphidum* of Linnæus. The manner in which this insect proves so destructive to the *Aphis* is different from that of the Lady-bird. The female Ichneumon, of which numbers may be found where *Aphides* are in plenty, settles on a stalk, or leaf, more or less covered with them, marches slowly over their bodies, feeling with its *antennæ* as it proceeds for one of a suitable size and age; which having discovered, it pushes forward its body, or abdomen, in an incurved state, and with a fine instrument at its extremity, invisible to the naked eye, punctures, and deposits an egg in, the body of the *Aphis*; which having done, it proceeds, and lays an egg in a similar way in the bodies of many others. The egg thus deposited quickly hatches, and becomes a small *larva*, or maggot, which feeds on the substance of the *Aphis*, and, having eaten the whole of it, the skin excepted, it changes to a *pupa*, or chrysalis; in which state when it has remained a sufficient time, it becomes an Ichneumon fly, which eats its way out of the *Aphis*, leaving the dry inflated skin of the insect adhering to the leaf, like a small pearl. Such may always be found where *Aphides* are in plenty. We have observed different species of *Aphides* to be infested with different Ichneumons.

In general the torpid *Aphis* submits quietly to this fatal operation; but we have observed some of them, especially one that feeds on the

* "Lady-bird, lady-bird, fly away home! Your house is on fire, your children at home"

sycamore,

ſycamore, which is much more agile than many of this race, endeavour to avoid the Ichneumon with great addreſs.

There is, perhaps, no genus of inſects which in their *larva* or maggot ſtate feed on ſuch a variety of food as the *Muſca*, or Fly. There is ſcarcely a part of nature, either animate or inanimate, in which they are not to be met with. One diviſion of them, called by Linnæus *Muſcæ aphidivoræ*, feeds entirely on *Aphides*. Of the different ſpecies of aphidivorous flies, which are numerous, having moſtly bodies variegated with tranſverſe ſtripes, their females may be ſeen hovering over plants infeſted with *Aphides*, among which they depoſit their eggs, on the ſurface of the leaf. The *larva*, or maggot, produced from ſuch eggs feeds, as ſoon as hatched, on the younger kinds of *Aphis*; and, as it increaſes in ſize, attacks and devours thoſe which are larger. Theſe *larvæ* are uſually of a pale colour, adhere cloſely to the leaf, along which they ſlowly glide, and are formed very tapering towards the head. When fully grown, they change to a *pupa*, or *chryſalis*, attached to the leaf, from whence iſſues the fly. The *larvæ* of theſe flies contribute their full ſhare to diminiſh the deſpoilers of Flora. To theſe three kinds of inſects, which are the chief agents in the hands of Nature for keeping the *Aphides* within their proper limits, we may add a few others which act a ſubordinate part in this neceſſary buſineſs of deſtruction.

The *larva* of the *Hemerobius* feeds on them in the ſame manner as that of the *Muſca aphidivora*, and depoſits its eggs alſo on the leaves of ſuch plants as are beſet with *Aphides*. The eggs of this *Hemerobius* ſtand on long filaments, which are attached by a baſe to the leaf, and have more the appearance of the filaments of flowers with their *antheræ* than the eggs of an animal. The number of theſe

theſe inſects being comparatively very ſmall, they may be conſidered rather as the caſual invaders of their exiſtence than the main hoſt of their deſtroyers.

The Earwig, which is in itſelf no contemptible enemy to plants, makes ſome atonement for its depredations by deſtroying the *Aphides*; eſpecially ſuch as reſide in the curled-up leaves of fruit-trees, and the purſes formed by certain *Aphides* on the poplars and other trees.

Laſtly, we may add as the enemies of theſe creatures, ſome of the ſmaller ſoft-billed birds, which feed generally on inſects, and which may frequently be ſeen buſily employed in picking them from the plants. Their utility did not eſcape the obſervation of the pleaſing author of the Seaſons. We ſhall quote the whole of what he writes on this ſubject, preſuming that none of our readers will think it too long; remarking, however, that he has fallen into the error of moſt others in regard to the manner in which theſe inſects are ſaid to be brought by the eaſterly winds, and that he confounded the miſchiefs of Caterpillars with thoſe of the *Aphis*.

"For oft engender'd by the hazy north,
Myriads on myriads, inſect armies warp
Keen in the poiſon'd breeze, and waſteful eat
Thro' buds and bark into the blacken'd core
Their eager way. A feeble race! yet oft
The ſacred ſons of vengeance, on whoſe courſe
Corroſive famine waits, and kills the year.
To check this plague, the ſkilful farmer chaff,
And blazing ſtraw, before his orchard burns,
Till, all involv'd in ſmoke, the latent foe
From every cranny ſuffocated falls;
Or ſcatters o'er the blooms the pungent duſt
Of pepper, fatal to the froſty tribe;
Or, when the envenom'd leaf begins to curl,
With ſprinkled water drowns them in their neſt;
Nor, while they pick them up with buſy bill,
The little trooping birds unwiſely ſcares.

When plants aſſume a ſickly appearance, or are disfigured by diſeaſe, from whatever cauſe the diſeaſe may ariſe, they are ſaid to be blighted. Blights originate from a variety of cauſes, the chief of which are unfavourable weather and inſects.

Two opinions prevail very generally in regard to blights: the one, that the inſects which are the cauſe of them are brought from a diſtance by eaſterly winds; the other, that they attach themſelves to none but plants already ſickly. Neither of theſe opinions, as far as I have obſerved, is founded in fact. I am induced, from the numerous obſervations I have made on inſects for a ſeries of years, (in purſuing the cultivation of plants) to conſider the *Aphis* as by far the moſt general cauſe of the diſeaſes diſtinguiſhed by the name of blights. Other inſects, it is true, more eſpecially the *larvæ* of ſome of the *Lepidoptera*, as thoſe of the *Phalænæ tortrices*, disfigure and do infinite miſchief to plants, by rolling and curling up the leaves. But theſe, for the moſt part confine themſelves to certain trees and plants. Their ravages alſo are of ſhorter duration, being confined to the growth of one brood, and they are alſo leſs fatal. It would be no difficult matter for me to fill a volume with obſervations, to which I have been an eye witneſs, of the injuries which plants ſuſtain from inſects; but that would be foreign to my preſent purpoſe, which is to ſhow that the *Aphis* is the grand cauſe of theſe diſeaſes, and to place the *modus operandi*, or the manner in which they effect this buſineſs, in its true light.

We are fully aware that certain gregarious inſects may at particular times riſe up in the air, and, if ſmall and light, be impelled by any wind that may chance to blow at the time; and on this principle we account for that ſhower of *Aphides* deſcribed by Mr. White to have fallen at Selborn. But certainly this is not the mode in which thoſe inſects are uſually diſperſed over a country. The phænomenon is too unuſual, the diſtribution would be too partial; for

Aphides,

Aphides, while at their higheſt point of multiplication, do not ſwarm like bees or ants, and fly off or emigrate in large bodies; but each male or female *Aphis*, at ſuch periods as they arrive at maturity, marches or flies off without waiting for any other. Yet it may happen that, from a tree or plant thickly beſet with them, numbers may fly off or emigrate together, being arrived at maturity at the ſame moment of time.

Detaching itſelf from the plant, each purſues a different route, intent on the great buſineſs of multiplying its ſpecies; and ſettles on ſuch plants in the vicinity as are calculated to afford nouriſhment to its young.

The common green *Aphis*, which is ſo generally deſtructive, lives during the winter ſeaſon on ſuch herbaceous plants as it remained on during the autumn, either in its egg or perfect ſtate. If the weather be mild, it multiplies greatly on ſuch herbage; as the ſpring advances, in May the males and females of theſe inſects acquire wings: and thus the buſineſs of increaſe, hitherto confined, is widely and rapidly extended, as the winged *Aphides*, by hop-planters called the Fly, may be ſeen from this period very generally ſitting on plants, and floating in the air in all directions.

Minutes of Appearances obſerved in the Aphis ſalicis *from the End of September to December 6th.*

The *Aphis ſalicis* is among the largeſt Engliſh ſpecies, and is found on the bark both of the trunk and branches of the *Salix triandra*, *fragilis*, and *viminalis*, but moſt abundantly on the laſt. The bodies of theſe inſects contain a red liquid, and hence perſons employed in ſtripping oſiers have their hands rendered apparently bloody by unavoidably bruiſing them.

Near the end of September multitudes of the full grown inſects of this ſpecies, both winged and others, are obſerved to deſert the

willows on which they feed, and to ramble ſolitarily over every neighbouring object, in ſuch numbers that we can handle nothing in their vicinity without cruſhing ſome of them. Are they retreating to freſh trees, on which to depoſit their young, or ſeeking ſome warmer ſituation for the winter ſeaſon? Vaſt numbers of them, moſtly in a younger ſtate, ſtill remain in large maſſes on the trees.

Though numberleſs inſects, Waſps in particular, were devouring the ſweets they depoſited, the Lady-bird *(Coccinella)* was the only one which preyed on the *Aphides* themſelves; and theſe towards the end of the month began to relax their depredations, and to retreat to their winter quarters.

As the ſeaſon advances, the *Aphides* are found higher on the trees, proceeding gradually upwards in queſt of new food. When the young *Aphis* is brought forth, and is completely diſengaged, it inſinuates itſelf under the body of its mother, and places itſelf cloſe to its elder brother or ſiſter, thus early manifeſting an attachment to that congregated ſtate of ſociety in which it afterwards exiſts.

If by ſtriking it you jar the branch of the tree on which *Aphides* are placed, or ſhould a waſp or other large inſect approach them ſuddenly, or rudely, the whole of them as it were in a maſs elevate their bodies and hind legs and put them in motion; and herein appear to conſiſt their whole powers of defence; in this ſtate their very fine white legs, thus elevated, give them a curious filamentous appearance. We have frequently obſerved white incruſtations adhering to different parts of their legs, wings, and bodies.

Oct. 12. Still obſervable in great maſſes on the large branches of the trees.

Many winged males now among them, yet no appearance of copulation. Many pregnant females emigrating from the maſs.

Nov. 8. A fine warm day, after many of violent and long continued rain, the *Aphides* were obſerved to be very much diminiſhed in

in number. On ſome of the branches they had quite diſappeared, but on others great numbers ſtill remained in maſſes. Diſeaſe was now making havock among them; the bodies of many were ſwollen and diſcoloured. Moſt of them were ſuſpended by the *proboſcis*, ſtill inſerted into the bark of the tree; their juices were of a deep purple or blackiſh hue. Not a Waſp to be ſeen, but few Flies, and fewer *Coccinellæ*, the only natural enemy to which we have obſerved this ſpecies to be ſubject.

Nov. 10. On opening the abdomen of one of the largeſt females, I counted ſixty-one young, large and ſmall.

Put by in three ſeparate pill-boxes, placed in a warm cloſet to the ſouth-weſt, many large pregnant apterous *Aphides*, and many males with their wings perfectly expanded, and others with their wings not expanded.

The large apterous *Aphides* depoſited young in the boxes, but all of them died in leſs than a fortnight. Theſe ſeveral *Aphides* were placed in this ſituation to ſee if they would live through the winter, as they would be out of the reach of froſt.

Nov. 21. Opened the body of a female *Aphis*, and found it to contain forty-ſix young; three parts of theſe at leaſt were ſuch, and the ſmalleſt of them had more the appearance of embryos than eggs.

At the cloſe of the month of May 1799, after a very long and hard winter, plants were more free from *Aphides* than uſual; yet, in ſheltered gardens particularly, I found them on the top ſhoots of trees, (none on herbaceous plants) as the currant, gooſeberry, apple, cherry, and common ſpindle tree. As yet, few of them had wings. It would appear from this circumſtance, that the female muſt lay her eggs in hard winters on the extremities of the branches.

Obſerved the excrement of a black *Aphis* clear and tranſparent, but the liquor from the tubular *Cornicula* was of a purple colour.

It appears that the excrementitious ſubſtance both of this black *Aphis* and the common green one cryſtallizes ſoon after it is evacuated at this ſeaſon of the year; for we obſerve a white ſubſtance on the leaves where the *Aphides* are, and ſcarcely any of the gloſſy honey-dew.

At twenty minutes paſt ſix in the evening of May 31ſt, I immerſed ſome black *Aphides* in water, with the leaves of the *Evonymus europæus* on which they were feeding, in two ſeparate glaſſes of water, and took them out at ten. All ſurvived the experiment.

At twelve at noon I immerſed ſome common green *Aphides* on gooſeberry ſhoots, and a black ſort on *Evonymus*, in water; when taken out at twelve at noon next day they were found every one dead.

TAB. V. fig. 1. repreſents part of a branch of the *Salix viminalis* with a number of ſpecimens of the *Aphis ſalicis.*

————fig. 2. is a female of the ſame ſpecies magnified, in the act of excluding its young.

V. *Remarks*